CLAIMS:

What is claimed is:

1. An integrated circuit device comprising:

a wafer having a first surface, a second surface opposite said first surface and an optical transmission interface extending from said first wafer surface through to said second wafer surface;

a semiconductor layer disposed on said first wafer surface;

a plurality of integrated circuits formed on said semiconductor layer;

an optical data bus extending through said optical transmission interface normal to said first wafer surface;

a plurality of external devices coupled to said optical data bus; and

a node formed on said semiconductor layer adjacent to said optical transmission interface, said node having means for optically coupling said plurality of integrated circuits and said optical data bus.

2. An integrated circuit device as recited in claim **1**, wherein said wafer is formed of a thermally conductive material.

3. An integrated circuit device as recited in claim **1**, wherein said wafer is formed of a material selected from the group consisting of diamond and sapphire.

4. An integrated circuit device as recited in claim **1**, wherein said semiconductor layer is formed of a material selected from the group consisting of silicon (Si), germanium (Ge),

gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

5. An integrated circuit device as recited in claim **1**, wherein each said integrated circuit is an application specific integrated circuit (ASIC).

6. An integrated circuit device as recited in claim **1**, wherein said means for optically coupling comprises:

a transmitter having a light source for emitting a beam of light and an external modulator, wherein said light source is disposed adjacent to said external modulator and said external modulator is disposed proximate to said optical transmission interface such that said beam of light transmits said external modulator and propagates in a direction parallel to said first wafer surface and normal to said optical data bus; and

a receiver having a detector, an amplifier and signal processing circuitry, said detector disposed adjacent said optical transmission interface facing said light source and said optical data bus, wherein said detector detects an optical signal emitted from said optical data bus in a direction normal thereto, and converts said signal to an electrical signal that is amplified by said amplifier.

7. An integrated circuit device as recited in claim **6**, wherein said light source is a hybrid element integral with said semiconductor layer.

8. An integrated circuit device as recited in claim **6**, wherein said light source is re-growth semiconductor material on silicon.

9. An integrated circuit device as recited in claim **8**, wherein said re-growth semiconductor material is a material selected from the group consisting of gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

10. An integrated circuit device as recited in claim **6**, wherein said light source is a porous silicon optical emitter.

11. An integrated circuit device as recited in claim **6**, wherein said light beam is a coherent monochromatic beam of light.

12. An integrated circuit device as recited in claim **6**, wherein said external modulator is an electro absorption modulator.

13. An integrated circuit device as recited in claim **6**, wherein said external modulator is a semiconductor laser diode modulator.

14. An integrated circuit device as recited in claim **13**, wherein said semiconductor laser diode modulator has a discrete channel spectrum of from 1300 nanometers (nm) to 1600 nanometers (nm).

15. An integrated circuit device as recited in claim **6**, wherein said external modulator is integral with said semiconductor layer.

16. An integrated circuit device as recited in claim **6**, wherein said external modulator is formed of a semiconductor material selected from the group consisting of gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

17. An integrated circuit device as recited in claim **6**, wherein said external modulator is formed of a millimeter wave integrated circuit material selected from the group consisting of indium, gallium, aluminum, arsenide, and phosphide.

18. An integrated circuit device as recited in claim **17**, wherein said millimeter wave integrated circuit material is compatible with a semiconductor material selected from the group consisting of gallium aresenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium aresenide (InAs).

19. An integrated circuit device comprising:

a plurality of wafers adjacently stacked, each wafer having a first surface, a second surface opposite said first surface and an optical transmission interface extending from said first wafer surface through to said second wafer surface, a semiconductor layer disposed on each said first wafer surface, and a plurality of integrated circuits formed on each said semiconductor layer, said plurality of integrated circuits including a node formed on said

semiconductor layer adjacent to said optical transmission interface, said node having means for coupling optical data into and out of said plurality of integrated circuits;

an optical data bus extending axially through each said optical transmission interface normal to each said first wafer surface at each said wafer node, said optical data bus having means for coupling optical data between one said wafer node and other wafer nodes located on said wafers within the stack; and

means for replacing a defective wafer of said stack.

20. An integrated circuit device as recited in claim **19**, wherein each said wafer is formed of a thermally conductive material.

21. An integrated circuit device as recited in claim **19**, wherein each said wafer is formed of a material selected from the group consisting of diamond and sapphire.

22. An integrated circuit device as recited in claim **19**, wherein each said semiconductor layer is formed of a material selected from the group consisting of silicon (Si), germanium (Ge), gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

23. An integrated circuit device as recited in claim **19**, wherein each said integrated circuit is an application specific integrated circuit (ASIC).

24. An integrated circuit device as recited in claim **19**, wherein said means for coupling optical data into and out of said plurality of integrated circuits comprises:

a transmitter having a light source for emitting a beam of light and an external modulator, wherein said light source is disposed adjacent to said external modulator and said external modulator is disposed proximate to said optical transmission interface such that said beam of light transmits said external modulator and propagates in a direction parallel to said first wafer surface and normal to said optical data bus; and

a receiver having a detector, an amplifier and signal processing circuitry, said detector disposed adjacent said optical transmission interface facing said light source and said optical data bus, wherein said detector detects an optical signal emitted from said optical data bus in a direction normal thereto, and converts said signal to an electrical signal that is amplified by said amplifier.

25. An integrated circuit device as recited in claim **24**, wherein said light source is a hybrid element integral with said semiconductor layer.

26. An integrated circuit device as recited in claim **24**, wherein said light source is re-growth semiconductor material on silicon.

27. An integrated circuit device as recited in claim **26**, wherein said re-growth semiconductor material is a material selected from the group consisting of gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

28. An integrated circuit device as recited in claim **24**, wherein said light source is a porous silicon optical emitter.

29. An integrated circuit device as recited in claim **24**, wherein said light beam is a coherent monochromatic beam of light.

30. An integrated circuit device as recited in claim **24**, wherein said external modulator is an electro absorption modulator.

31. An integrated circuit device as recited in claim **24**, wherein said external modulator is a semiconductor laser diode modulator.

32. An integrated circuit device as recited in claim **31**, wherein said semiconductor laser diode modulator has a discrete channel spectrum of from 1300 nanometers (nm) to 1600 nanometers (nm).

33. An integrated circuit device as recited in claim **24**, wherein said external modulator is integral with said semiconductor layer.

34. An integrated circuit device as recited in claim **24**, wherein said external modulator is formed of a semiconductor material selected from the group consisting of gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium arsenide (InAs).

35. An integrated circuit device as recited in claim **24**, wherein said external modulator is formed of a millimeter wave integrated circuit material selected from the group consisting of indium, gallium, aluminum, arsenide and phosphide.

36. An integrated circuit device as recited in claim **35**, wherein said millimeter wave integrated circuit material is compatible with a semiconductor material selected from the group consisting of gallium aresenide (GaAs), gallium phosphide (GaP), indium phosphide (InP), and indium aresenide (InAs).

37. An integrated circuit device comprising:

a wafer having a first surface, and a second surface opposite said first surface;

a semiconductor layer disposed on said first wafer surface;

a plurality of integrated circuits formed on said semiconductor layer;

an optical data bus extending along an edge of said wafer normal to said first wafer surface;

a plurality of external devices coupled to said optical data bus; and

a node formed on said semiconductor layer adjacent to said wafer edge, said node having means for optically coupling said plurality of integrated circuits and said optical data bus.

38. An integrated circuit device as recited in claim **37**, wherein said means for optically coupling comprises:

a transmitter having a light source for emitting a beam of light and an external modulator, wherein said light source is disposed adjacent to said external modulator and said external modulator is disposed proximate to said wafer edge such that said beam of light transmits said external modulator and propagates in a direction parallel to said first wafer surface and normal to said optical data bus; and

a receiver having a detector, an amplifier and signal processing circuitry, said detector disposed adjacent said wafer edge facing said light source and said optical data bus, wherein said detector detects an optical signal emitted from said optical data bus in a direction normal thereto, and converts said signal to an electrical signal that is amplified by said amplifier.

39. An integrated circuit device comprising:

a plurality of wafers adjacently stacked, each wafer having a first surface, a second surface opposite said first surface, a semiconductor layer disposed on each said first wafer surface, and a plurality of integrated circuits formed on each said semiconductor layer, said plurality of integrated circuits including a node formed on said semiconductor layer adjacent to an edge of said wafer, said node having means for coupling optical data into and out of said plurality of integrated circuits;

an optical data bus extending axially through each said wafer edge normal to each said first wafer surface at each said wafer node, said optical data bus having means for coupling optical data between one said wafer node and other wafer nodes located on said wafers within the stack; and

means for replacing a defective wafer of said stack.

40. An integrated circuit device as recited in claim **39**, wherein said means for coupling optical data into and out of said plurality of integrated circuits comprises:

a transmitter having a light source for emitting a beam of light and an external modulator, wherein said light source is disposed adjacent to said external modulator and said external modulator is disposed proximate to said wafer edge such that said beam of light transmits said external modulator and propagates in a direction parallel to said first wafer surface and normal to said optical data bus; and

a receiver having a detector, an amplifier and signal processing circuitry, said detector disposed adjacent said wafer edge facing said light source and said optical data bus, wherein said detector detects an optical signal emitted from said optical data bus in a direction normal thereto, and converts said signal to an electrical signal that is amplified by said amplifier.